Instruction Manual

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MA25217

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INSTRUCTION MANUAL

For

AC VOLT-AMP-WATTMETER

Model 115

SERIAL NO. 74194

It is essential that this instruction book be read thoroughly before putting the equipment in service.

IM-313-MA

PAN/50/889

890803
115MN.HMM

IMPORTANT

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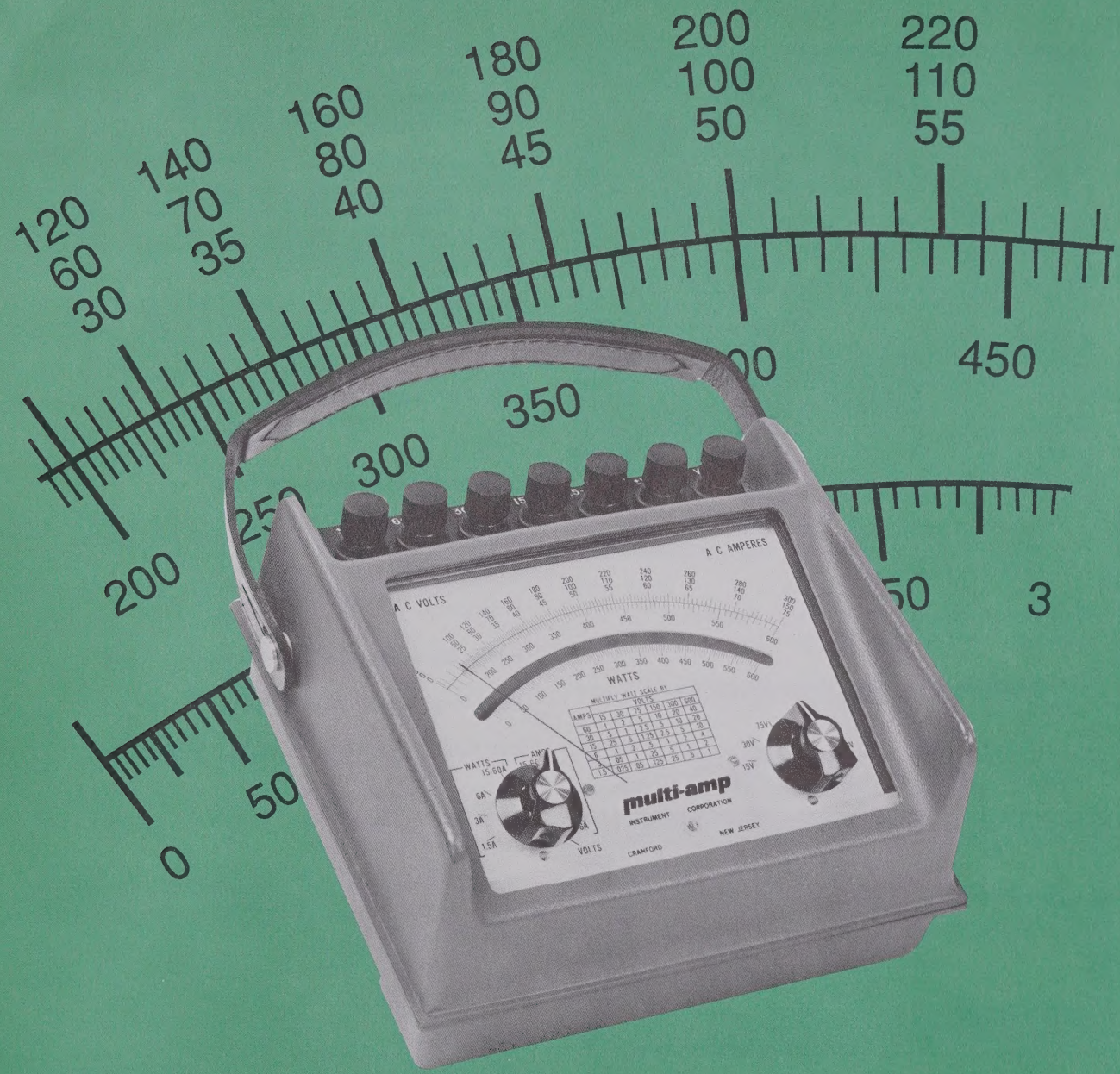

HIGH ACCURACY METERS

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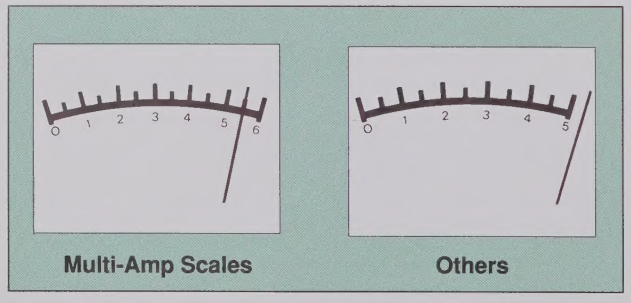
Features

- Versatile, easy-to-use combinations of functions and ranges
- Scales are subdivided into units of 1, 2, 5 and their decimals eliminating awkward fractional scale readings.
- Range switching is standard—convenient, time-saving and safe.
- All current switching is "make-before-break".
- Fast response
- Broad temperature
- AC instruments measure and indicate true RMS.
- Rugged taut-band mechanism is mounted in a steel shell for excellent shielding and protection.
- Accuracy: 1/3% of full scale; 1/2% available at lower cost
- Easy-to-read. Sloped console design, plus built-in retractable stand, facilitate reading.
- Design ensures that CT secondaries are never opened.
- Current ranges extend beyond traditional values to improve resolution and reading accuracy.



Multi-Amp Scales **Others**

- Terminals are located away from operator for safety.
- Binding posts and switches are fully protected by tough case-shoulders.
- Static-free, non-glare tempered glass window
- High-impact thermoplastic case with leather carrying handle
- Built for years of daily field use

Description

Featuring a shock-resistant taut band mechanism, versatile range switching and ability to operate over a broad range of temperatures, Multi-Amp® high accuracy analog meters are designed with power applications in mind.

Used for years in some of the most extreme field conditions, these meters have proven to be reliable and dependable. The terminals and face of each meter are protected by high case-shoulders. All meters come in sturdy impact-resistant enclosures with leather carrying straps.

The large scale is easy-to-read and features ranges that extend beyond traditional values for improved resolution.

All units can be ordered with 1/3% accuracy or, at a lower cost, 1/2% accuracy.

General Specifications

Insulation Test: 2600 volts RMS, terminals to case for one minute

Frequency: 48 to 62 Hz

Scale: 90˚ mirrored, 5.1 inches long (129.5 mm)

Shielding: Magnetically shielded

Dial Position: 17˚ from horizontal, 28˚ with built-in stand

Accuracy: 1/2% series is calibrated for use in both horizontal or tilted positions. 1/3% series is calibrated for use in horizontal position only.

Temperature Influence: Less than 0.1% full scale value over a +/- 10˚C change from 25˚C for all functions and ranges

Dimensions

7.4 D x 7.7 W x 4.5 H in.
(188 D x 196 W x 114 H mm)

Net Weight

4.0 to 6.0 lbs. (1.8 to 2.7 kg) depending on model

All meters are manufactured to meet or exceed all ANSI C39.1 Standard Requirements for Electrical Indicating Instruments.

Standard Instruments

Model 115 AC Volt-Amp-Wattmeter

Ranges:
Voltage: 0 to 15/30/75/150/300/600
Current: 0 to 1.5/3/6/15/30/60
Scale Divisions: 120/150
Single-phase Watts: 36 ranges, 0 to 15 up to 24,000
Scale Divisions: 120
Switching: All voltage ranges switched.
Current ranges switched through 6 amperes.

Model 125 AC Volt-Ammeter

Ranges:
Voltage: 0 to 3/7.5/15/30/75/150/300/750
Current: 0 to 1.5/3/6/15/30/60/120
Scale Divisions: 120/150

Model 135 AC Ammeter, Type A

Ranges: 0 to 0.6/1.5/3/6/15/30/60/120
Scale Divisions: 120/150
Switching: Through 15-ampere range

Model 145 AC Voltmeter,Type A

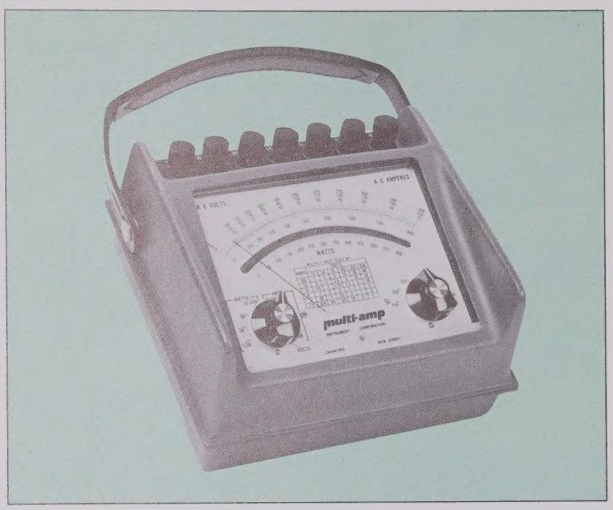
Ranges: 0 to 3/7.5/15/30/75/150/300/750
Scale Divisions: 150
Switching: All ranges

Burden Data — AC Instruments

Range In Volts	Approx. Impedance in Ohms	Range in Amperes	Approx. Impedance in Ohms
750	149,000	120	.0007
600	116,00	60	.0013
300	59,000	30	.0025
150	15,000	15	.0045
75	3,700	6	.024
30	590	3	.053
15	150	1.5	.165
7.5	75	0.6	.633
3	30		

Wattmeters:

Potential circuit at 120 volts: 1.03 volt-amperes
Current Circuit at 5 amperes: 0.69 volt-amperes



Model 115 offers the versatility of an ammeter combined with a voltmeter and wattmeter.

Model 155 Single-Phase AC Wattmeter

Current (switch-selected): 1.5/3/6/15 amperes
Voltage (switch-selected): 75/150/300 volts
Ranges: 0 to 75/150/300/600/750/1200/1500/3000 watts
Scale Divisions: 120

Model 165 AC Milli-Ammeter

Ranges: 0 to 10/25/50/100/250/500/1000/2500/5000/10,000
Scale Divisions: 100/125
Switching: All ranges

Model 235 DC Ammeter

Ranges: 0 to 1/5/10 self-contained, plus 50mV range for higher current measurements through an external shunt
Scale Divisions: 100
Switching: All self-contained ranges

See Ordering Information on next page.

Optional Accessories

Test Leads

Test leads for these meters must be ordered *separately.* Available leads include:

5-foot (1.5m) potential leads (1 pr.)
Part No. 7933

5-foot (1.5m) light current leads (1 pr.)
Part No. 7934

5-foot (1.5m) high current leads (1 pr.)
Part No. 7935

Suggested Lead Usage

Model No.	Lead Part No.		
	7933	7934	7935
115	X	X	X
125	X	X	X
135		X	X
145	X		
155	X	X	
165		X	
235		X	

Carrying Cases

Optional carrying cases are made of a high-impact, thermoplastic with polyurethane foam padding. Space for leads and a carrying handle provide maximum protection during transportation and storage.

Model CC-1: Single-meter case

Model CC-2: Two-meter case

Ordering Information

Item	1/2% Accuracy Model No.	1/3% Accuracy Model No.
AC Volt-Amp-Wattmeter	115-2	115-3
AC Volt-Ammeter	125-2	125-3
AC Ammeter	135-2	135-3
AC Voltmeter	145-2	145-3
AC Wattmeter	155-2	155-3
AC Milli-Ammeter	165-2	165-3
DC Ammeter	235-2	235-3

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GENERAL DESCRIPTION

This manual covers operation, maintenance, test and calibration of Multi-Amp Model 115 AC volt-amp-wattmeter.

The Model 115 portable instrument incorporates a rugged taut-band, self-shielding, friction-free, bar-ring movement mounted in a steel shell. This provides magnetic shielding for the entire meter. Among its many outstanding features are true rms measurements, extremely low meter losses, high accuracy, broad temperature compensation, continuous rating and high momentary overload capability.

SPECIFICATIONS

RANGES	Voltage:	0-15/30/75/150/300/600 volts all ranges switched
	Current:	0-1.5/3/6/15/30/60 amperes Switched through 6-ampere range
	Watt:	36 ranges: 0-15 through 0-24,000 watts
SCALE DIVISIONS		150 divisions for 1.5, 3, 15 and 30-ampere ranges and all voltage ranges
		120 divisions for 6 and 60-ampere ranges and all watt ranges
SCALE		90 degrees, mirrored, 5.1-inch length
ACCURACY AT 77˚F (25˚C)		Model 115-2: 1/2% of full scale value with instrument in horizontal position or raised by built-in stand.
		Model 115-3: 1/3% of full scale value with instrument in horizontal position only.
TEMPERATURE INFLUENCE		Less than 0.1% of full scale value over ±10˚C change from 25˚C for all ranges.
FREQUENCY RANGE		54 to 66 hertz for 60 hz. instruments 46 to 54 hertz for 50 hz. instruments
HOUSING		High impact, self-extinguishing, thermoplastic case equipped with non-reflective, tempered glass window.
	Dimensions:	7.7" x 7.4" x 4.5" 19.56 cm x 18.8 cm x 11.43 cm
	Net Weight:	6 lbs. (2.72 kg)

THEORY OF OPERATION

This instrument uses a special thermal element which converts the alternating current input into a proportional dc signal. This in turn drives a dc moving coil mechanism. This instrument uses multi-range current and potential transformers and switches to provide the wide range of measurements available. The current range switch has make-before-break contacts for protection against open-circuiting input.

OPERATING INSTRUCTIONS

Use of Model 115 volt-amp-wattmeter is very straight-forward and requires no special skills or knowledge. Although the design of this instrument is for normal field use, treat the unit with the same care given to any quality instrument to ensure maximum trouble-free service. To maintain readings within the accuracy of the instrument, take the following simple preliminary steps:

1. Place meter in the horizontal position on a level surface.

   NOTE: Using the 1/2% accuracy instruments with the built-in stand either in the up or down position will still have 1/2% accuracy. 1/3% class instruments must be flat to maintain 1/3% accuracy.

2. Before using, check to see that the pointer reads exactly zero. If not, carefully turn the zero adjust screw until the pointer lines up with the zero mark.

3. The instrument uses a knife-edge pointer and mirrored scale to abolish parallax errors. When taking reading, always make certain to hide the pointer's reflection by the pointer.

4. In choosing a range, remember the full scale value determines the meter's accuracy. Therefore, a range should be chosen so the expected voltage or current will be as near full scale as possible. When in doubt in choosing a range, select the highest range and then switch down to avoid over-ranging meter.

Model 115 volt-amp-wattmeter provides extensive versatility through its many ranges. The instrument can measure the quantities independently or can measure all three quantities simultaneously without de-energizing the meter.

Potential Measurements:

Place left-hand switch in the VOLTS position. Then select desired range with right-hand switch, and connect test leads from binding posts labeled "V" and "±V". When in doubt of the proper voltage range, start with the voltage range switch in the 600V position. Then switch down to the proper scale. This protects the instrument from an accidental overload.

Current Measurements:

Model 115 has five (5) binding posts associated with the current circuit: a common labeled "±A"; one each for the 60A, 30A and 15A ranges; and one labeled "1.5-6A" for selection of the desired range by the AMPS section of the left-hand switch.

Connect the instrument in series with the source of current by connecting one test lead to the "±A" binding post. Then connect the second test lead to the proper range binding post. Be sure the test leads are large enough to carry the expected current.

To protect the instrument from accidental overload when using the "1.5-6A" binding post, start with the current range switch in the 6A position. Then switch down to the scale you wish to use. Operating the current range switch on an energized meter will not harm the unit.

Power Measurements:

The design of the Model 115's watts scale allows the most typical combinations of current and voltage to result in full scale deflection. As an example, full scale defection results when applying 5 amperes to the 6-ampere range and applying 120 volts to the 150-volt range. The same holds true when applying 240 volts to the 300-volt range with 5 amperes applied to the 6-ampere range.

As a result, the operator must be careful when making power measurements so the resultant combination of applied current and voltage does not result in greater than full scale deflection, regardless of power factor. Over-ranging will result when simultaneously applying both full scale current and voltage.

Before applying potential to the meter, adjust the voltage range switch first to the proper range for the potential input to the binding posts labeled "V" and "±V".

Before applying current to the meter, adjust the current range switch to the proper range for the applied current. Connect the instrument in series with the source current by connecting one lead to the "±A" binding post. For upscale deflection of the meter, connect the current so the instantaneous current flows into the "±A" binding post when the voltage drop is from the ±V to the V binding posts.

Take readings on the "0-600" WATTS scale and then multiply by the proper factor as shown by the MULTIPLY WATT SCALE BY matrix. Determine the multiplier according to the actual CURRENT and VOLTAGE input ranges on the current and potential switches.

For example, if using the 6A and 150V ranges , multiply the scale reading by "1". Therefore, the scale is reading directly. If the 3A and 75V ranges are in use, the scale reading multiplier is 0.25; therefore, a scale reading of 400 would show a 100-watt reading (400 x 0.25 = 100 watts).

When making power measurements, Model 115 can also measure the applied voltage and current by changing the left-hand switch to the proper current range or the VOLTS position. To avoid overloading the instrument, the operator should switch through the lower current ranges to the desired range as quickly as possible.

ACCURACY CHECK

Under normal use, check the meter for accuracy once every six (6) months. The following tests are suggested:

A. Balance Test

1. Place meter on a level surface with the meter scale in a horizontal plane and turn zero adjust screw so the meter reads exactly zero.

2. Tilt the meter so the meter scale is vertical, then rotate the meter so the needle pointer is first horizontal and then vertical. If the pointer varies more than ±1/64-inch in either position, the meter should be re-balanced following the Balancing Procedure given under CALIBRATION before proceeding.

B. Electrical Test

Check the meter's accuracy in an ambient room temperature of 25°C (77°F) and with the instrument sitting in the horizontal position on a level surface.

1. Connect the meter to a variable source of 60 hz. voltage and current (or 50 hz., if appropriate) and a standard meter. The standard meter should have at least twice the accuracy of the instrument under test. For example, check a 1/2% instrument using a 1/4% instrument.

2. Check to be sure the meter reads exactly zero; if not, turn zero adjust screw.

3. To verify accuracy of power measurements, apply potential and current simultaneously to the instrument and check each cardinal division on the watts scale for accuracy. Since the applied potential and currents are fixed by potential and current transformer ratios, use any combination of voltage or current to verify accuracy. After establishing accuracy of any watts range, it is not necessary to check all combinations of ranges. For convenience, recommendation is to use the 150 volts and 6-ampere ranges for electrical test.

4. To verify accuracy of current measurements, start with the meter under test on its lowest range and the standard meter on a proper range. Then slowly increase the current until both meters read full scale.

NOTE: Since most other meters do not incorporate the extended current ranges used in Multi-Amp Instruments, it is not always possible to have both instruments read full scale together. In these cases, the ranges of the standard meter should be chosen so the meter which is not at full scale is as close to full scale as possible. The following table will be of assistance in using a standard meter with traditional ranges:

Range of Multi-Amp Instrument	Range of Standard Instrument	Test Current
1.5	2	1.5 Amperes
3	5	3.0 Amperes
6	5	5.0 Amperes
15	20	15.0 Amperes
30	50	30.0 Amperes
60	50	50.0 Amperes

5. Reduce current and check each cardinal division on the scale.

6. Repeat Steps 4 & 5 for each current range on the meter.

7. To verify accuracy of potential measurements, start with the meter under test in its lowest range and the standard meter on an appropriate range. Then slowly increase the potential until both meters read full scale.

8. Reduce potential and check each cardinal division on the scale.

9. Repeat Steps 7 & 8 for each potential range on the meter.

C. If meter does not check within its specified accuracy, refer to the CALIBRATION SECTION.

MAINTENANCE

A. Care of Windows
The windows of these meters require little maintenance. To clean, simply wipe lightly with lens tissue, facial tissue or dry, soft cloth.

B. Routine Maintenance
Recommendation is that the instrument be subject to a periodic maintenance once per year. This maintenance check should consist of the following:

1. Remove the meter from its case as follows:

   a. Place meter face down on a table and remove the four (4) screws on the back.

   b. Remove the calibration certificate.

   c. Remove bottom half of case and disconnect the lead coming from inside the metal shell to the common (±A) binding post. (This is the extreme right-hand binding post looking at the bottom).

   d. Remove top half of case by gripping both sides with fingers and spreading. Use thumbs to hold down window and lift the case over the gasket on one side and slide the other side off. (It is not necessary to remove range switch knobs before taking off case top).

2. Check condition of window gasket.

3. Remove switch knobs and check gaskets below switch knobs.

4. Check all binding post connections for tightness.

5. Replace top half of case and turn meter face down. Reconnect ±A binding post.

6. Replace bottom half of case, calibration certificate and four (4) screws.

7. Perform ACCURACY CHECK.

CALIBRATION

Performed, if necessary, following Electrical Test.

A. Balancing Procedure
Before performing any electrical calibration, the meter movement must be balanced. Balance movement as follows:

1. Remove meter from case as described in Routine Maintenance.

2. Place meter on table with the scale in the horizontal position and adjust pointer to read exactly zero.

3. Tilt meter so the scale is vertical and rotate to the left until the pointer is horizontal. If the pointer does not read zero (±1/64-inch), adjust the two side balance weights until it does read zero.

4. Now rotate the meter to the right until the pointer is vertical. If the needle does not read zero (±1/64-inch), adjust the two side balance weights until it does read zero.

B. Electrical Calibration
The scales of Model 115 volt-amp-wattmeters are hand-drawn during factory calibration and although it is usually possible to use the same scale when re-calibrating, in some cases it may be necessary to hand-calibrate a new scale.

NOTE: **NO ATTEMPT SHOULD BE MADE TO ELECTRICALLY CALIBRATE THE INSTRUMENT UNLESS THE USER HAS A CALIBRATED SOURCE WHICH ALLOWS THE ACCURATE SETTING OF ALL CURRENT LEVELS TO MAXIMUM REQUIRED VALUE.**

1. Remove meter from case as described under Routine Maintenance, if this has not already been done.

2. Place meter on a level surface in the horizontal position.

3. Verify that the pointer reads exactly zero. If not, turn zero adjust screw until getting a zero reading.

4. The following WATT, CURRENT AND VOLTAGE CALIBRATION sequence of adjustments should be carefully followed because of the interdependence of the adjustments on each other.

5. If you must adjust any of the calibration trim pots, first remove the white tape from the left-hand side of the metal shell. Save the tape to cover the opening after completing adjustments.

C. Watt Calibration

1. Connect current binding posts in series with a calibrated current source using leads heavy-enough to carry the test current. Connect the voltage binding posts in parallel with a calibrated source and in phase with the current.

   To show the manner of connection, one each of the current and voltage terminals have a ± mark. Connect the terminals so marked in phase or to the same side of the line to ensure correct directions of deflection. If the lead to the ±A binding post was disconnected when removing the meter from case, connect the source to the lead and not to the ±A terminal.

2. If using a switched range, be sure the switch is in the proper position.

3. Slowly increase watts and check each cardinal point from zero to end-scale mark. The reading of each point should be within rated full scale accuracy.

4. If any of the cardinal points are out of tolerance, adjust trim pot R3 to bring them within tolerance. See Figure No. 1 for location of R3.

5. Check the cardinal points and end-scale values of all other ranges to see that they are within tolerance. Note that the calibration of all ranges is fixed by transformer ratios and component tolerances. After making any adjustments with trim pot R3, check all ranges for accuracy.

D. Current Calibration

1. Connect meter in series with a calibrated source using leads heavy-enough to carry the test current. Use any range of the instrument for calibrating. Connect the leads to the ±A and appropriate range terminal. If the lead to the ±A binding post was disconnected when removing meter from case, connect the source to the lead and not to the ±A terminal.

2. If using a switched range, be sure switch is in the proper position.

3. Slowly increase current and check each cardinal point from zero to end-scale mark. The reading of each point should be within rated full scale accuracy.

4. If any of the cardinal points are out of tolerance, adjust trim pot R2 (see Figure No. 1) to bring them within tolerance.

5. Check the cardinal points and end-scale values of all other ranges to see that they are within tolerance. Note that the calibration of all ranges is fixed by transformer ratios and component tolerances. After making any adjustment with trim pot R2, check all ranges for accuracy.

6. If full scale travel cannot be achieved using R2, adjust trim pot R3 to produce end-scale travel.

   NOTE: If it was necessary to adjust R3, recheck the watt ranges and the accuracy of the cardinal points on the current ranges.

E. Voltage Calibration

1. Connect meter in parallel with a calibrated source.

2. Set the left-hand switch to the VOLTS position.

3. Set the voltage range switch to 150-volt range.

4. Slowly increase voltage and check each cardinal point from zero to end-scale mark. The reading of each point should be within rated full scale accuracy.

5. If any of the cardinal points are out of tolerance, use the voltage adjustment trim pot R1 (refer to Figure No. 1) to bring them within tolerance.

6. Check the full scale and each cardinal point on the 75 and 300-volt ranges. The reading of each point should be within rated full scale accuracy.

   NOTE: The adjustments made on the 150-volt range should also bring these ranges within tolerance.

7. Switch to the 15-volt range.

8. Slowly increase voltage and check each cardinal point from zero to end-scale mark. The reading of each point should be within rated full scale accuracy.

9. If any of the cardinal points are not within tolerance, make an adjustment by turning trim pots R17 and R18 (refer to Figure No. 1) equal amounts.

   NOTE: If R17 and R18 were adjusted, recheck cardinal points and end-scale value.

10. Switch to the 30-volt range.

11. Slowly increase voltage and check each cardinal point from zero to end-scale mark. The reading of each point should be within rated full scale accuracy.

    NOTE: Adjustments made on the 15-volt range should also bring the 30-volt range within tolerance.

12. Switch to the 600-volt range.

13. Slowly increase voltage and check each cardinal point from zero to end-scale mark. The reading of each point should be within rated full scale accuracy.

14. If any of the cardinal points are not within tolerance, make an adjustment using trim pot R5 (refer to Figure No. 1).

    NOTE: If R5 was adjusted, recheck cardinal points and end-scale value.

15. After making all adjustments, use liquid cement such as glyptal, to lock the trim pots.

16. Replace white tape covering opening to trim pots.

17. Replace meter in its case following procedure in MAINTENANCE section.

18. If the meter does not meet rated specifications after completing the foregoing calibration procedures, contact the factory before attempting any further calibration or troubleshooting.

MODEL 115 TRIM POT ARRANGEMENTS

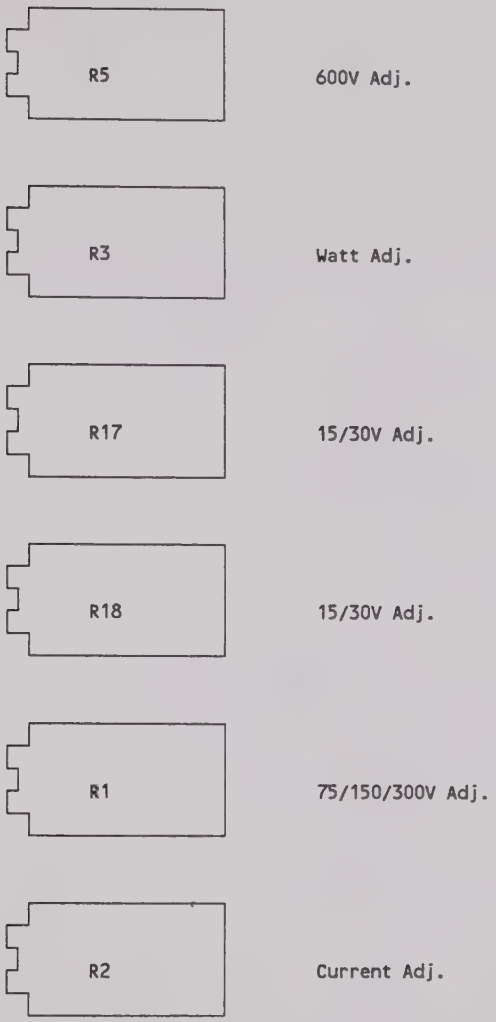
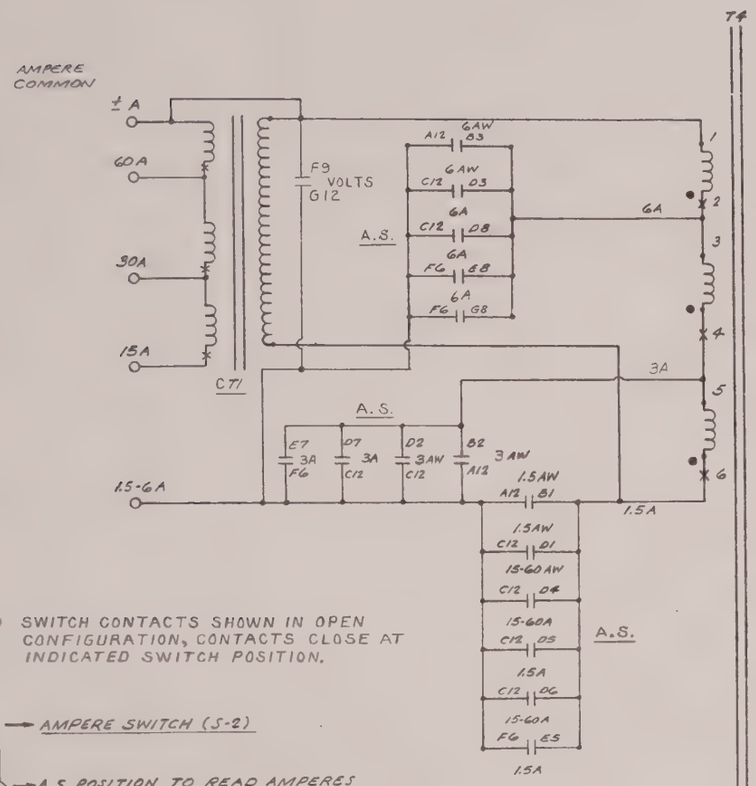
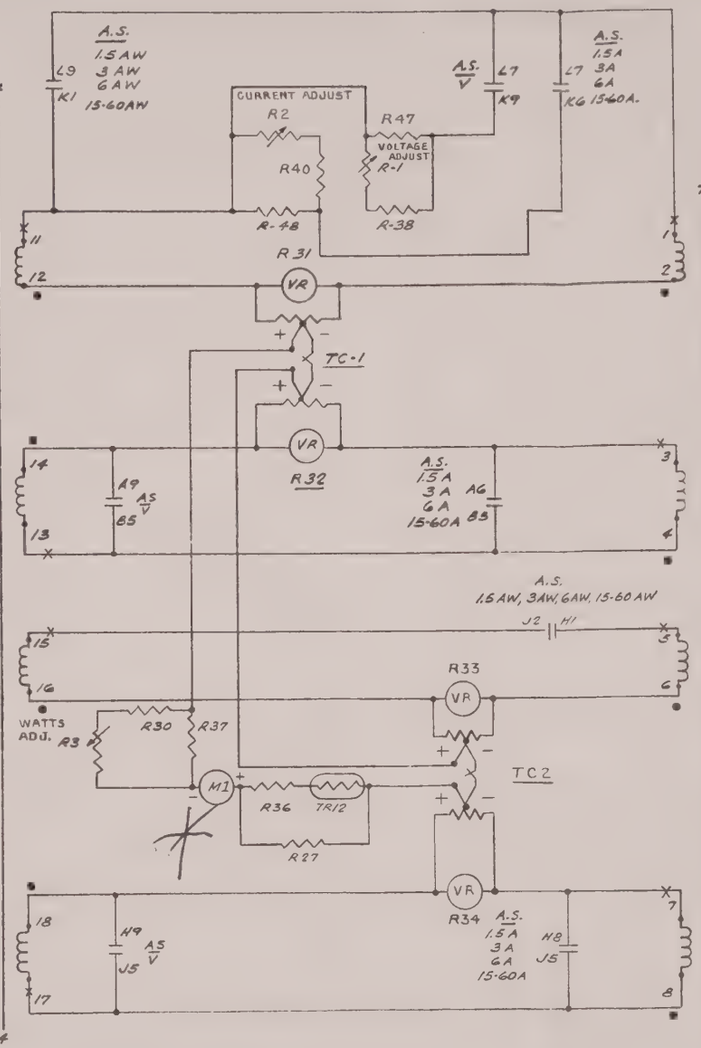
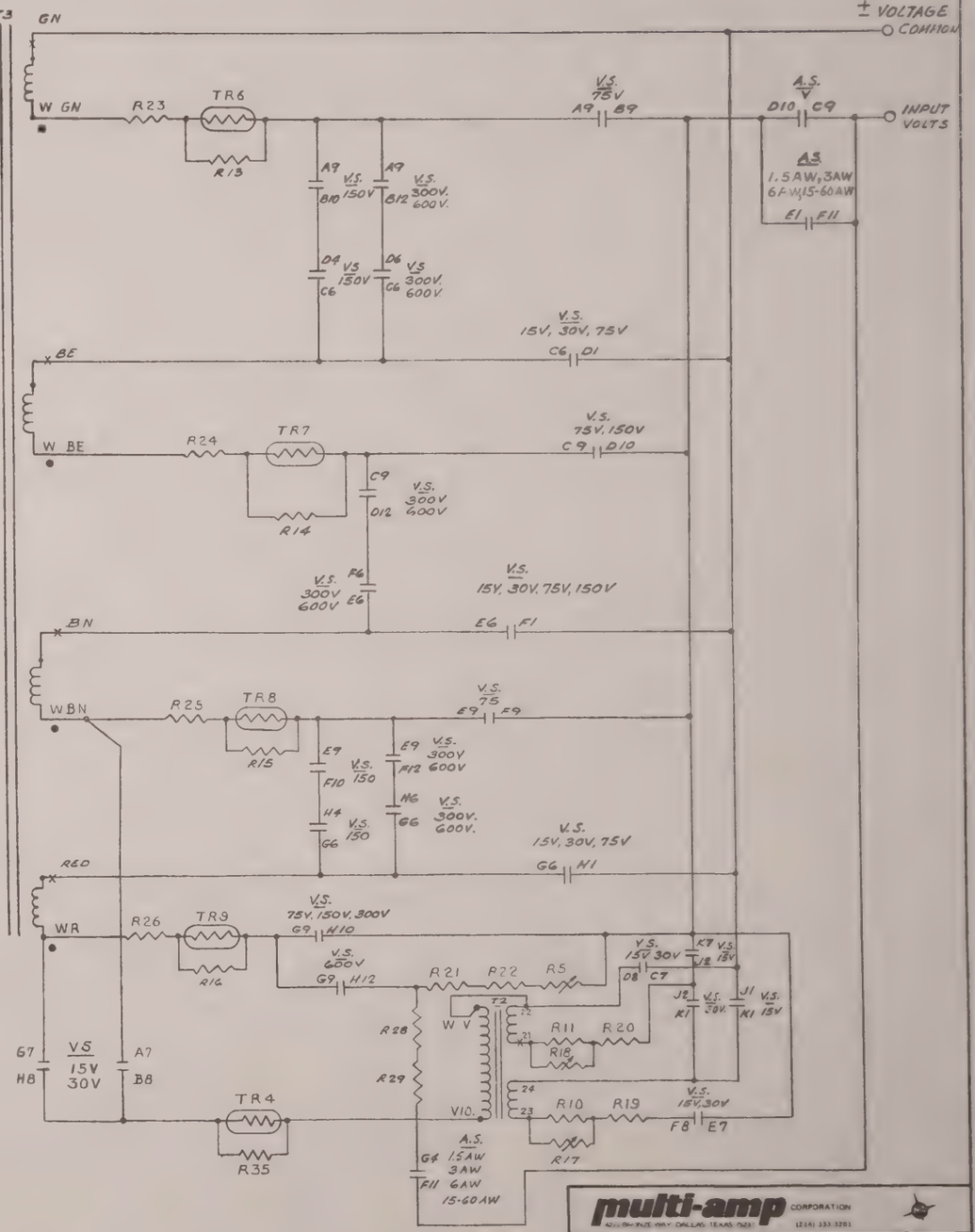


Figure 1. Order of trim pots viewed from left side of Model 115 VAWM.

DWG NO 14936 L		REV NO	ECN NO
7	5760 8-27-80	1	4338 3-7-79
8	9242 4-14-81	2	4517 6-1-79
9	10202 9-3-81	3	4628 7-31-79
10	12231 9-16-82	4	4879 2-22-80
11	13446 7-14-83	5	5142 3-12-80
		6	5440 5-21-80







A1 B1 1.5A SWITCH CONTACTS SHOWN IN OPEN CONFIGURATION, CONTACTS CLOSE AT INDICATED SWITCH POSITION.

A.S. → AMPERE SWITCH (S-2)

1.5A, 3A, 6A, 15-60A → A.S. POSITION TO READ AMPERES

V → A.S. POSITION TO READ VOLTS

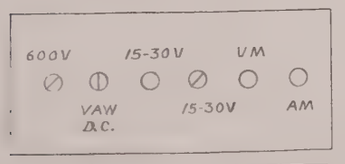
1.5AW, 3AW, 6AW, 15-60AW → A.S. POSITIONS TO READ WATTS

V.S. → VOLTAGE SWITCH (S-1)

15V, 30V, 75V, 150V, 300V, 600V → V.S. POSITIONS TO READ VOLTS AND WATTS

T → TRANSFORMER

CALIBRATION POT. LOCATION



BINDING POST END OF INSTRUMENT

REPLACEMENT PARTS LIST

ITEM	PART NO.	DESCRIPTION	QTY.
CT1	8414	CURRENT TRANSF.	1
M1	7100	METER MECHANISM	1
R1,2	7508	TRIMPOT 1C Ω	2
R3	7710	TRIMPOT 20 Ω	1
R5	7510	TRIMPOT 10K Ω	1
R10,11,37	3212	RESISTOR 16 Ω	3
R13-16	7505	RESISTOR 1/4W 300Ω	4
R17,18	7509	TRIMPOT 20Ω	2
R19,20	5149	RESISTOR 184 Ω	2
R21,22	7504	27K Ω	2
R23-26	5289	11.25K Ω	4
R28		SELECTED	1
R29	7541	RESISTOR 400K Ω	1
R31-34	7500	VARISTOR	4
R35	7506	RESISTOR 62 Ω	1
R36,47,48	7534	5 Ω	3
R27,30	7944	3.3 Ω	2
R38,40	6259	RESISTOR 2.43 Ω	2

ITEM	PART NO.	DESCRIPTION	QTY.
S1	6264	VOLTAGE SWITCH	1
S2	3635	CURRENT SWITCH	1
T2	5148	POTENTIAL TRANSF.	1
T3	4467	POTENTIAL TRANSF.	1
T4	4468	CURRENT TRANSF.	1
TC1,2	7519	THERMOCOUPLE	2
TR4	7514	THERMISTOR 100 Ω	1
TR6-9	7513	THERMISTOR 500 Ω	4
TR12	7521	THERMISTOR 15 Ω	1
	XB23	BLACK BINDING POST	5
	156	RED BINDING POST	2
	7304	LEATHER CARRYING HANDLE	1
	8392	GLASS WINDOWASSEMBLY	1
	7383	WINDOW GASKET	1
	7311	SWITCH KNOBS	2
	7300	RETRACTABLE TILT STAND	1

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TOLERANCES	DWN. FARROW	APPD	SCALE
DECIMAL ±.010 FRACTIONAL ±1/64 UNLESS NOTED	CHK'D. JMK 3-79	DATE	SHT. 1 OF 1

TITLE: SCHEMATIC & REPLACEMENT PARTS VOLT-AMP-WATTMETER

PART NO.	DWG. NO.	REV.
MODEL 115	14936 D	11

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MP MASTER
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